Class B thermal perfomance verification
File: H_COP_TCS_TCS4.xls
Author: E. Picallo

Procedure Summary

Objectives

This procedure describes the steps needed to check the thermal performance of the HIFI class B heaters (control loops #20 for FHWOV, control loop #26 for FHHRH, control loop #39 for FHWOH and control loop #43 for FHHRV) and for the STRs class B heater (control loop #37).

Summary of Constraints

The class B algorithm applies only if the controlled unit is ON. When the unit is OFF, its temperature is controlled on the basis of the simpler class A control law.

The ThermAvgTemp_XXX TM parameters are part of a periodic HK packet (P64), thus they are downlinked only when the telemetry bit rate is more then 5 kbps.

The TCS_THM_XXX TM parameters are part of HK Diagnostic TCS, thus they are downlinked only when the packet is enabled and the telemetry bit rate is more then 5 kbps.

The THERM_B_PK_X parameters are part of HK Diagnostic TCS Class B Output power, thus they are downlinked only when the packet is defined and enabled and the telemetry rate is more than 5 Kbps

The HERM_B_PK_X parameters are assigned to the enabled Class B loops in the order of the loop number to Class B loops that have the connected unit On (Class B loops with connected unit Off act as Class A loops). These datapool parameters will be re-assigned every 10s when the temperature monitoring is done to the class B loops.

Spacecraft Configuration

Start of Procedure

CMDU in default configuration;
STR ON or STR ON and HIFI ON

End of Procedure

CMDU in default configuration;
STR ON or STR ON and HIFI ON

Reference File(s)

Input Command Sequences

Output Command Sequences

HCTTCS4

Referenced Displays

ANDs **GRDs** **SLDs**

ZAZAO999	ZGZ2W999	(None)
ZAD85999	ZGZ2G999	
	ZGZ2M999	
	ZGZ2Y999	
	ZGZ32999	

Configuration Control Information

DATE	FOP ISSUE	VERSION	MODIFICATION DESCRIPTION	AUTHOR	SPR REF
10/10/08		1	Created	E. Picallo	
08/12/08		2	Enable/disable TCS & ASW 2 Diag. packet added	E. Picallo	
09/01/09		3	CDMU ASW V3.8 and BSW V2.4 alignment	E. Picallo	
21/01/09		4	Non Operative & Operative ranges for control loops 20 and 39 corrected	E. Picallo	
23/01/09	2	4.01	Validation : Control loop B Output power clarification notes added	E. Picallo	
24/03/09	2.2	5	Loop 26 (close to FHHRH) and loop 43 (close to FHHRV) verifications added□ Diagnostic packet ID 126 including all 5 ThermBPk defined ansd enabled□ Avg temperature description updated	E. Picallo	
07/04/09	2.3	6	steps 6 & 9: STRs Qinst = 21.98W corrected	E. Picallo	

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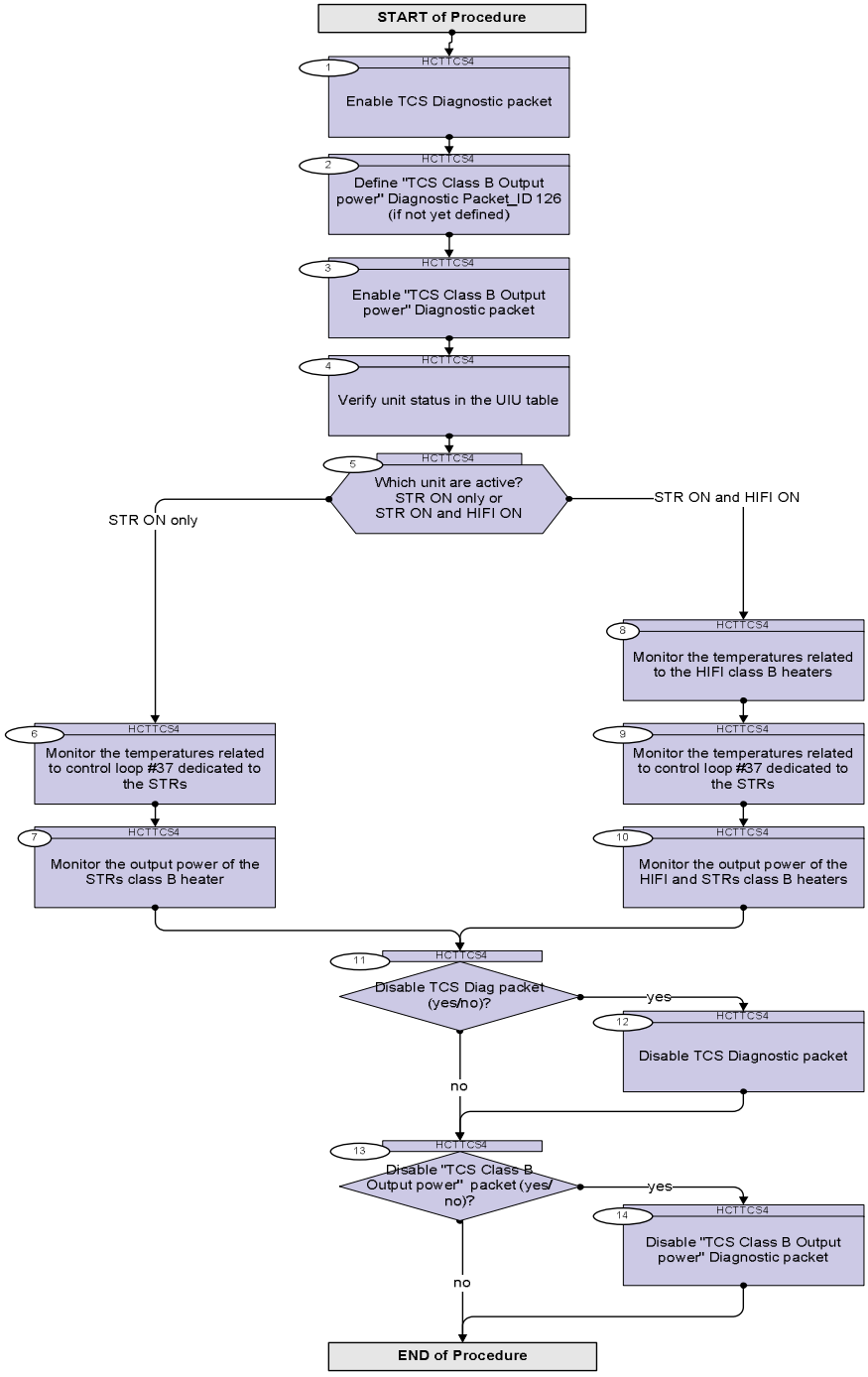
Procedure Flowchart Overview



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Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Beginning of Procedure		
		TC Seq. Name :HCTTCS4 (Class B heater check) *TimeTag Type:* N *Sub Schedule ID:*		
1		*Enable TCS Diagnostic packet*		Next Step: 2
		Call procedure "Enable or disable the generation of an housekeeping or diagnostic packet" H_FCP_DHS_3033 **1) Acquire the list of the current enabled TM packets** **2) Verify if the TCS Diagnostic packet is enabled:** **TCS -> subtype=26, packet-ID=100** **3) If it is disabled, enable it**		
		Execute Procedure: **H_FCP_DHS_3033** **Enable or disable the generation of an housekeeping or diagnostic packet**		
2		*Define "TCS Class B Output power" Diagnostic Packet_ID 126 (if not yet defined)*		Next Step: 3
		Check if the selected Packet_ID = 126 is defined. If it is Not yet defined, define it.		
2.1		*Check if the Packet_ID 126 is not yet defined*		
		After reception of this TC, the CDMU BSW shall generate aTM packet with a copy of the structure definition of the requested Diagnostic Packet ID 126.		
		Execute Telecommand **ReportDiagPackDef** *Command Parameter(s) :* **N DH030180** **HK_PKT_ID DH031180** *TC Control Flags :* **GBM IL DSE** **--Y -- ---** *Subsch. ID : 10* Det. descr. : Report Diagnostic Packet Definitions	**DC303180** **1 <dec>** (Def) **126 <dec>**	
2.2		*Diagnostic Packet_ID 126 Not yet defined?*		

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		In case the specified Packet_ID=126 in TC(3,11) is not yet defined the following TC(1,8) shall be received.		
		Verify Packet Reception **TC Execution Failure - HK-Diag Packet Not Defined** *Packet Details:* **APID:** **Type:** **Subtype:** **PI1:** **PI2:**	**D_TcExeF113** **16** **1** **8** **13**	
2.3		*Send TC(3,2) to define Packet_ID=126 diagnostic packet*		□
		Execute Telecommand **TCS Class B Output power** *Command Parameter(s) :* **HK ID** **XH100991** **SID** **XH101991** **sample interval** **XH102991** **SEGM ID** **XH103991** **PID** **XH105991** **PID** **XH105991** **PID** **XH105991** **PID** **XH105991** **PID** **XH105991** *TC Control Flags :* **GBM IL DSE** **--Y -- ---** *Subsch. ID : 30* Det. descr. :	**XC341991** **126 <dec>** (Def) **30006 <dec>** (Def) **1 <dec>** (Def) **0 <hex>** (Def) **2788 <dec>** (Def) **2789 <dec>** (Def) **2790 <dec>** (Def) **2791 <dec>** (Def) **2792 <dec>** (Def)	
2.4		*Send TC(3,11) to acquire the report of the new diagnostic Packet_ID=126*		□
		After reception of this TC, the CDMU BSW shall generate aTM packet with a copy of the structure definition of the requested Diagnostic Packet ID 126.		
		Execute Telecommand **ReportDiagPackDef** *Command Parameter(s) :* **N** **DH030180** **HK_PKT_ID** **DH031180** *TC Control Flags :* **GBM IL DSE** **--Y -- ---** *Subsch. ID : 10* Det. descr. : Report Diagnostic Packet Definitions	**DC303180** **1 <dec>** (Def) **126 <dec>**	

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
3		*Enable "TCS Class B Output power" Diagnostic packet*		Next Step: 4
		Call procedure "Enable or disable the generation of an housekeeping or diagnostic packet" H_FCP_DHS_3033 **1) Acquire the list of the current enabled TM packets** **2) Verify if the "TCS Class B Output power" packet is enabled(subtype=26, packet-ID=126)** **3) If it is disabled, enable it**		
		Execute Procedure: **H_FCP_DHS_3033** **Enable or disable the generation of an housekeeping or diagnostic packet**		
4		*Verify unit status in the UIU table*		Next Step: 5
4.1		*Verify STRs status in UIU*		□
		Verify Telemetry **Str1FuncSts** **DEG01170**		AND=ZAZAO999
		Verify Telemetry **Str2FuncSts** **DEG00170**		AND=ZAZAO999
		The unit ID for STR (loop index 37) are considered ON, for thermal control purposes, when at least one of the two units is ON.		
4.2		*Verify HIFI units in UIU*		□
		Verify Telemetry **HifiWovFuncSts** **DEL49171**		AND=ZAZAO999
		Verify Telemetry **HifiHrhFuncSts** **DEL46171**		AND=ZAZAO999
		Verify Telemetry **HifiWohFuncSts** **DEL40171**		AND=ZAZAO999
		Verify Telemetry **HifiHrvFuncSts** **DEL41171**		AND=ZAZAO999
5		*Which unit are active?* *STR ON only or* *STR ON and HIFI ON*		Next Step: STR ON only 6 STR ON and HIFI ON 8

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
6		*Monitor the temperatures related to control loop #37 dedicated to the STRs*		Next Step: 7
		Acquire average temperature of thermal control loop 37 dedicated to the STRs (HPS7/12 HCS1) **Operative range: Min = -3 ℃; Max = 30 ℃** **Non operative range: Min = -10 ℃; Max = 30 ℃** **Tref: set point 0 ℃ ; TrefMin = -2 ℃ ; TrefMax = 2 ℃** **QINST: 21.98 W @27V**		
		Verify Telemetry **ATemp37_STRs DEA9C170**		GRD=ZGZ2W999
		Verify Telemetry **THM_75_STRs TM075601**		GRD=ZGZ2W999
		Verify Telemetry **THM_123_STRs TM123601**		GRD=ZGZ2W999
		Verify Telemetry **THM_171_STRs TM171601**		GRD=ZGZ2W999
		Verify that the STRs temperature remains stable around the Tref = 0ºC		
7		*Monitor the output power of the STRs class B heater*		Next Step: 11
		WARNING: The THERM_B_PK_X parameters are assigned to the enabled Class B loops in the order of the loop number to Class B loops that have the connected unit On (Class B loops with connected unit Off act as Class A loops). These datapool parameters will be re assigned every 10s when the temperature monitoring is done to the class B loops.		
		Only STR unit is ON, so only one related Class B control loop is active, the THERM_B_PK_1 parameter shall be assigned in the following way: **DEAE4170 (ThermBPk1)= Loop #37 (STRs) output power**		
		Verify Control loop B Output power Telemetry **ThermBPk1 DEAE4170**	**< 21.98 <dec>**	AND=ZAD85999
		The Output Power of the class B heater must be inferieur to the parameter Qinst, used by the Class B algorithm and stored in the TCT, which indicates the max power that can be dissipated by the heater circuit.		
8		*Monitor the temperatures related to the HIFI class B heaters*		Next Step: 9

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		For the Herschel HIFI the temperature stability requirements are such that the, heaters are operated by means of a fine control law (PID regulation) of a Class B. **This procedure describes the steps needed to Monitor the thermal performance of the Herschel HIFI class B heaters, when HIFI ON.** **The following HIFI units are controlled by Class B loops:** **FHWOV (FIRST HIFI WBS Optics Vertical Polarisation)** **FHHRH (FIRST HIFI High Resolution spectrometer Oriz Pol.)** **FHHRV (FIRST HIFI High Resolution spectrometer Vert. Pol.)** **FHWOH (FIRST HIFI WBS Optics Orizontal Polarisation)**		
8.1		*Monitor the control loop 20 dedicated to the FHWOV*		
		Acquire average temperature of thermal control loop 20 dedicated to the FHWOV (HPS4/15 HCS2) **Operative range: Min = 2 ℃; Max = 12 ℃** **Non operative range: Min = -20 ℃; Max = 12 ℃** **Tref: set point 4.5 ℃ ; TrefMin = 2.5 ℃ ; TrefMa x = 6.5 ℃** **QINST: 23.84 W @27V**		
		Verify Telemetry **ATemp20_FHWOV DEA8B170**		GRD=ZGZ2G999
		Verify THM 1 FHWOV Telemetry **THM_60_FHWOV TM060601**		GRD=ZGZ2G999
		Verify THM 2 FHWOV Telemetry **THM_108_FHWOV TM108601**		GRD=ZGZ2G999
		Verify THM 3 FHWOV Telemetry **THM_156_FHWOV TM156601**		GRD=ZGZ2G999
		Verify that the FHWOV temperatures remains stable around the Tref = 4.5ºC		
8.2		*Monitor the control loop 26 dedicated to the FHHRH*		
		Avquire average temperature of thermal control loop dedicated to the FHHRH (HPS5/HCS2) **Operative range: Min = 25 ℃; Max = 31 ℃** **Non operative range: Min = -22 ℃; Max = 31 ℃** **Tref: set point 28 ℃ ; TrefMin = 26 ℃ ; TrefMax = 30 ℃** **QINST: 38.98 W @27V**		

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Verify Telemetry **ATemp26_FHHRH DEA91170**		GRD=ZGZ2M999
		Verify THM 1 FHHRH Telemetry **THM_66_FHHRH TM066601**		GRD=ZGZ2M999
		Verify THM 2 FHHRH Telemetry **THM_114_FHHRH TM114601**		GRD=ZGZ2M999
		Verify THM 3 FHHRH Telemetry **THM_162_FHHRH TM162601**		GRD=ZGZ2M999
		Verify that the FHHRH temperatures remains stable around the Tref = 28ºC		
8.3		*Monitor the control loop 39 dedicated to the FHWOH*		
		Acquire average temperature of thermal control loop 39 dedicated to the FHWOH (HPS7/ HCS3) **Operative range: Min = 1 ℃; Max = 11 ℃** **Non operative range: Min = -15 ℃; Max = 11 ℃** **Tref: set point 3.5 ℃ ; TrefMin = 1.5 ℃ ; TrefMa x = 5.5 ℃** **QINST: 33.15 W @27V**		
		Verify Telemetry **ATemp39_FHWOH DEA9E170**		GRD=ZGZ2Y999
		Verify THM 1 FHWOH Telemetry **THM_64_FHWOH TM064601**		GRD=ZGZ2Y999
		Verify THM 2 FHWOH Telemetry **THM_112_FHWOH TM112601**		GRD=ZGZ2Y999
		Verify THM 3 FHWOH Telemetry **THM_160_FHWOH TM160601**		GRD=ZGZ2Y999
		Verify that the FHWOH temperatures remains stable around the Tref = 3.5ºC		
8.4		*Monitor the control loop 43 dedicated to the FHHRV*		
		Acquire average temperature of thermal control loop 43 dedicated to the FHHRV (HPS8/HCS1) **Operative range: Min = 19 ℃; Max = 25 ℃** **Non operative range: Min = -25 ℃; Max = 25 ℃** **Tref: set point 22 ℃ ; TrefMin = 20 ℃ ; TrefMax = 24℃** **QINST: 38.98 W @27V**		
		Verify Telemetry **ATemp43_FHHRV DEAA2170**		GRD=ZGZ32999

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Verify THM 1 FHHRV Telemetry **THM_61_FHHRV TM061601**		GRD=ZGZ32999
		Verify THM 2 FHHRV Telemetry **THM_109_FHHRV TM109601**		GRD=ZGZ32999
		Verify THM 3 FHHRV Telemetry **THM_157_FHHRV TM157601**		GRD=ZGZ32999
		Verify that the FHHRV temperatures remains stable around the Tref = 22ºC		
9		*Monitor the temperatures related to control loop #37 dedicated to the STRs*		Next Step: 10
		Acquire average temperature of thermal control loop 37 dedicated to the STRs (HPS7/12 HCS1) **Operative range: Min = -3 ℃; Max = 30 ℃** **Non operative range: Min = -10 ℃; Max = 30 ℃** **Tref: set point 0 ℃ ; TrefMin = -2 ℃ ; TrefMax = 2 ℃** **QINST: 21.98 W @27V**		
		Verify Telemetry **ATemp37_STRs DEA9C170**		GRD=ZGZ2W999
		Verify Telemetry **THM_75_STRs TM075601**		GRD=ZGZ2W999
		Verify Telemetry **THM_123_STRs TM123601**		GRD=ZGZ2W999
		Verify Telemetry **THM_171_STRs TM171601**		GRD=ZGZ2W999
		Verify that the STRs temperature remains stable around the Tref = 0ºC		
10		*Monitor the output power of the HIFI and STRs class B heaters*		Next Step: 11
		WARNING: The THERM_B_PK_X parameters are assigned to the enabled Class B loops in the order of the loop number to Class B loops that have the connected unit On (Class B loops with connected unit Off act as Class A loops). These datapool parameters will be re assigned every 10s when the temperature monitoring is done to the class B loops.		

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		The STR and HIFI units are ON, so the five related Class B control loops are active, the THERM_B_PK_X parameters shall be assigned in the following way: **DEAE4170 (ThermBPk1)= Loop #20 (FHWOV) output power** **DEAE5170 (ThermBPk2) = Loop #26 (FHHRH)output power** **DEAE6170 (ThermBPk3) = Loop #37 (STRs) output power** **DEAE7170 (ThermBPk4) = Loop #39 (FHWOH) output power** **DEAE8170 (ThermBPk5) = Loop #43 (FHHRV) output power**		
		Verify Control loop B Output power Telemetry **ThermBPk1 DEAE4170**	**< 23.84 <dec>**	AND=ZAD85999
		Verify Control loop B Output power Telemetry **ThermBPk2 DEAE5170**	**< 38.98 <dec>**	AND=ZAD85999
		Verify Control loop B Output power Telemetry **ThermBPk3 DEAE6170**	**< 21.98 <dec>**	AND=ZAD85999
		Verify Control loop B Output power Telemetry **ThermBPk4 DEAE7170**	**< 33.15 <dec>**	(None)
		Verify Control loop B Output power Telemetry **ThermBPk5 DEAE8170**	**< 38.98 <dec>**	(None)
		The Output Power of the class B heater must be inferieur to the parameter Qinst, used by the Class B algorithm and stored in the TCT, which indicates the max power that can be dissipated by the heater circuit.		
11		*Disable TCS Diag packet (yes/no)?*		Next Step: yes 12 no 13
		If the TCS Diagnostic packet is not anymore needed, disable it.		
12		*Disable TCS Diagnostic packet*		Next Step: 13
		Call procedure "Enable or disable the generation of an housekeeping or diagnostic packet" H_FCP_DHS_3033 **Disable the TCS Diagnostic packet:** **TCS -> subtype=26, packet-ID=100**		
		Execute Procedure: **H_FCP_DHS_3033** **Enable or disable the generation of an housekeeping or diagnostic packet**		
13		*Disable "TCS Class B Output power" packet (yes/no)?*		Next Step: yes 14 no END

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		If the "TCS Class B Output power" Diagnostic packet is not anymore needed, disable it.		
14		*Disable "TCS Class B Output power" Diagnostic packet*		Next Step: END
		Call procedure "Enable or disable the generation of an housekeeping or diagnostic packet" H_FCP_DHS_3033 Disable the "TCS Class B Output power" Diagnostic packet: TCS -> subtype=26, packet-ID=126		
		Execute Procedure: **H_FCP_DHS_3033 Enable or disable the generation of an housekeeping or diagnostic packet**		
		End of Procedure		